

Application No: 10/037,258

AMENDMENTS TO THE CLAIMS

A detailed listing of all claims that are, or were, in the present application, irrespective of whether the claim(s) remains under examination in the application are presented below. The claims are presented in ascending order and each includes one status identifier. Those claims not cancelled or withdrawn but amended by the current amendment utilize the following notations for amendment: 1. deleted matter is shown by strikethrough for six or more characters and double brackets for five or less characters; and 2. added matter is shown by underlining.

1. (Currently amended) A fuel injector being fluidly coupled to a source of low pressure fuel and having a fuel pressure intensifier, the fuel intensifier hydraulically amplifying the fuel pressure for injection at a relatively high pressure, comprising:

a fuel injection pressure control valve for preparing fuel pressure; being in flow communication with a source of pressurized actuating fluid and selectively porting such actuating fluid to the fuel intensifier for hydraulic amplification of the fuel pressure; and

a fuel injection timing control valve for controlling the timing of a fuel injection event by controlling flow through an orifice, the orifice being in fluid communication with an actuation chamber, the actuation chamber having an inlet orifice and a vent orifice, the fuel injection pressure control valve and the fuel injection timing control valve being independently controllable.

2. (Original) The fuel injector of claim 1 wherein the fuel injection pressure control valve opens a window of injection opportunity and the fuel injection timing control valve controls the timing and duration of an injection event that occurs within the window of injection opportunity.

3. (Original) The fuel injector of claim 2 wherein the fuel injection pressure control valve opens a window of injection opportunity during which an actuation pressure is made available for use to intensify a fuel pressure.

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4. (Original) The fuel injector of claim 2 wherein the fuel injection timing control valve controls the timing and duration of an injection event that occurs within the window of injection opportunity to define fuel injection parameters.
5. (Original) The fuel injector of claim 4 wherein the fuel injection parameters occurring within an injection event include at least one of the parameters being start of injection, end of injection, interruption of injection, timing of interruption of injection, and duration of interruption of injection.
6. (Original) The fuel injector of claim 1 wherein the fuel injection timing control valve provides for selective independent control of pilot injection, main injection and rate shaping within a single shot injection event.
7. (Original) The fuel injector of claim 1 wherein fuel injection pressure preparation and fuel injection timing control are internally determined and are decoupled.
8. (Original) The fuel injector of claim 1 wherein the fuel injection timing control valve has relatively less flow area in relation to the fuel injection pressure control valve, the lesser flow area enhancing the response time of the fuel injection timing control valve for improving the shaping of the injection event as desired.
9. (Original) The fuel injector of claim 1 wherein a full actuation pressure is available from the fuel injection pressure control valve for the duration of an injection event, thereby providing maximum injection pressure throughout the injection event without regard to shaping of the injection event as desired.
10. (Previously Presented) The fuel injector of claim 1 wherein the fuel injection pressure control valve for preparing fuel pressure is cycled opened and closed a single time during each injection event and the fuel injection timing control valve may be independently cycled opened and closed a plurality of cycles during the injection event for effecting shaping of the injection event as desired.

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11. (Currently amended) A hydraulically actuated, electronically controlled unit injector having an inlet for admitting non-fuel actuating fluid to the injector and a fuel inlet for admitting a quantity of fuel at a pressure that is less than a pressure necessary to open a needle valve to cause fuel injection, an intensifier for selectively pressurizing the quantity of fuel to a pressure sufficient to open the needle valve when the intensifier is acted upon the actuating fluid, the pressurized fuel being available for control of the needle valve continuously during an injection event, the unit injector comprising:

a timing controller in fluid communication with the needle valve and with the intensifier being decoupled from actuation of the intensifier and controlling the shifting of the valve between an open and a closed disposition during an injection event by controlling a flow of pressurized fuel from the intensifier to the needle valve, the timing controller having a valve, the valve controlling flow through an orifice, the orifice being in fluid communication with an actuation chamber, the actuation chamber having an inlet orifice and a vent orifice.

12. (Original) The hydraulically actuated, electronically controlled unit injector of claim 11 wherein the timing controller directly controls the shifting of the needle valve.

13. (Previously Presented) The hydraulically actuated, electronically controlled unit injector of claim 12 wherein the timing controller directly controls the shifting of the needle valve by selectively porting a flow of pressurized fuel to exert a force on a needle valve surface, the force acting to bias the needle valve in a closed disposition.

14. (Original) The hydraulically actuated, electronically controlled unit injector of claim 11 wherein the timing controller includes an electronically actuated controller valve, the controller valve being in fluid communication with a fuel passage extending between the intensifier and the needle valve, the fuel passage conveying high pressure fuel.

15.-17. (Cancelled)

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Claim Rejection under 35 U.S.C. § 102

Claims 1-4, 7, 9, and 11-14 were rejected under 35 USC 102(b) as being anticipated by Ishida. Ishida has a single orifice to the actuation chamber. As amended, the independent claims of the present application have an actuation chamber having both an inlet and a vent orifice to the actuation chamber.

Claims 1-4, 7, 9, and 11-14 were rejected under 35 USC 102(b) as being anticipated by Miller. Miller has an actuation chamber having both an inlet and a vent orifice to the actuation chamber. Miller actively controls both orifices with valving. As amended, the independent claims of the present application have an actuation chamber having both an inlet and a vent orifice to the actuation chamber, but only one orifice is controlled by a valve.

In view of the foregoing, it is submitted that neither Ishida nor Miller anticipates claims 1-4, 7, 9, and 11-14 as amended and it is requested that the rejections be withdrawn.

Claim Rejection under 35 U.S.C. § 103

Claim 5 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ishida. There is no teaching, suggestion, or structure in Ishida for employing an actuation chamber that has more than one orifice. As noted above, claim 1, from which claim 5 depends, includes a limitation to an actuation having two orifices. In view of this, the rejection is respectfully requested to be withdrawn.

Claims 6 and 10 were rejected under 35 USC 103(a) as being unpatentable over Ishida in view of Nishimura. Both Ishida and Nishimura are common rail type injectors. There is no structure, teaching, or suggestion in either Ishida or Nishimura for having an injector that includes a fuel pressure intensifier for amplifying fuel pressure. There is no motivation for combining the teachings of Ishida and Nishimura to define an injector having an intensifier. They are limited to a common rail. Accordingly the rejection is respectfully requested to be withdrawn.

Claims 15-17 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ishida or Miller in view of Drummond. Claims 15-17 have been cancelled.